

# An Introduction to **HOMER**

## Hybrid Optimization Model for Electric Renewables

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# What is HOMER?

A tool for designing hybrid power systems comprising:

- wind turbines



- PV



- batteries

- diesels

- microturbines



- fuel cells



- small hydro



- small modular biomass



- grid connection



# What is HOMER?

## Key HOMER concepts:

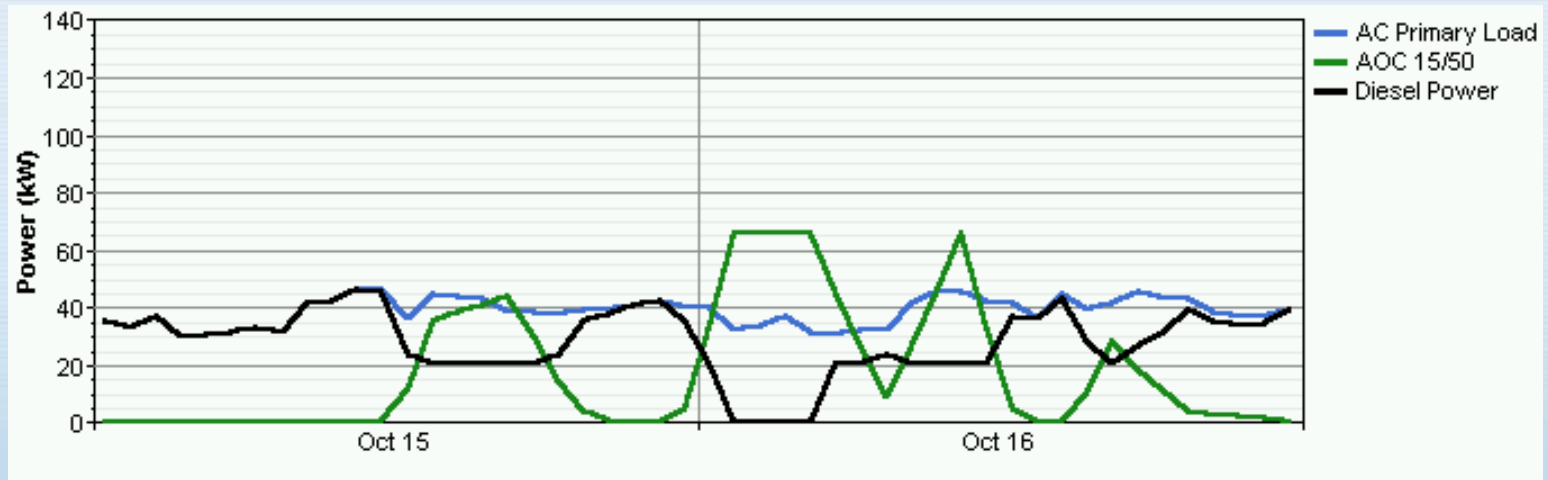
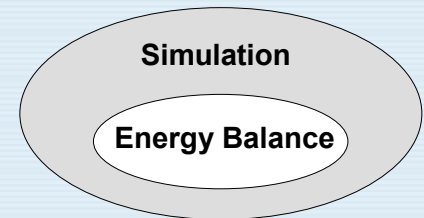
- ***hourly energy balance:***
  - compare the energy supply and demand in a single hour
  - decide how to operate dispatchable sources (generators, batteries, grid)

Energy Balance

# What is HOMER?

## Key HOMER concepts:

- **simulation:** performing an energy balance for each hour of the year to determine feasibility and costs

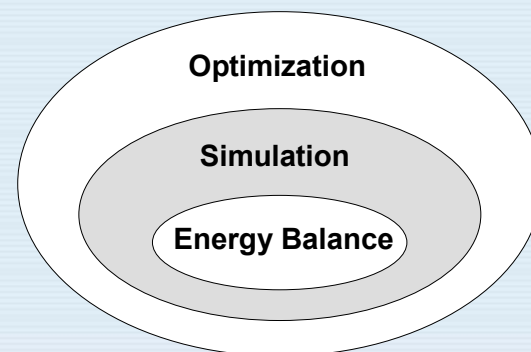




# What is HOMER?

## Key HOMER concepts:

- **optimization**: the process of finding the least-cost configuration of a hybrid power system



System Designs










Graphic Display

Double click on a system below for details.

☐ Categorized

☒ Overall

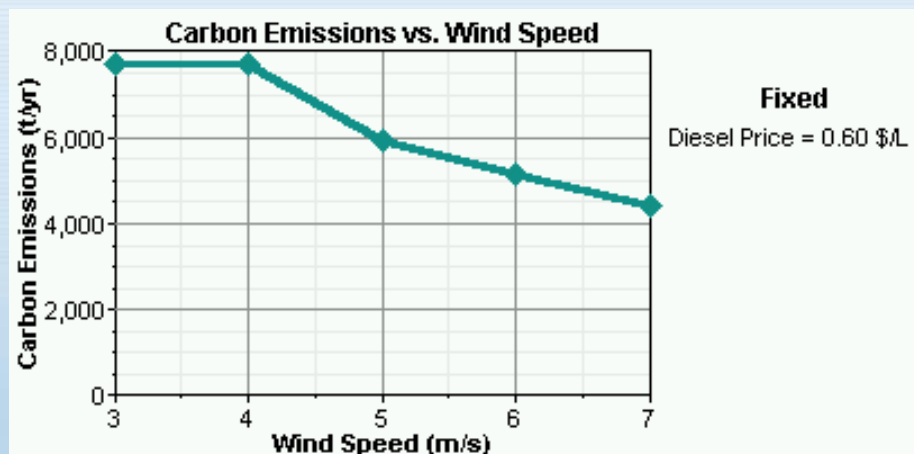
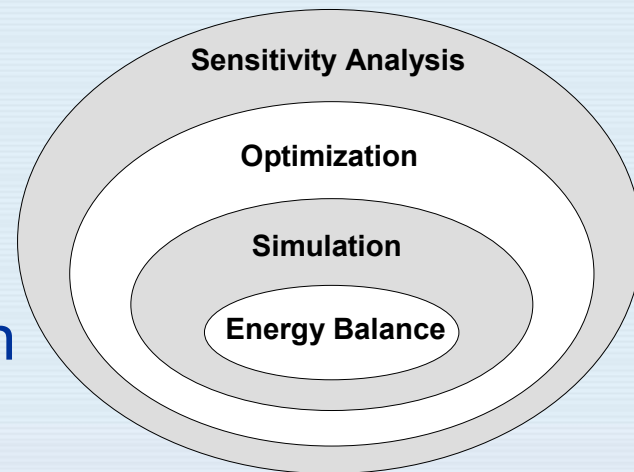
Export

		WT 1	Dsl (kW)	Total Capital	Total NPC	COE (\$/kWh)	Ren. Frac.	Unsrv. Frac.	Excess Frac.	Diesel (L)	Dsl (hrs)
		2	70	\$ 242,400	\$ 1,200,212	0.263	0.37	0.00	0.34	71,084	6455
		3	70	\$ 352,400	\$ 1,242,420	0.272	0.43	0.00	0.47	63,672	5731
		1	70	\$ 132,400	\$ 1,279,849	0.281	0.23	0.00	0.17	87,654	8076
			70	\$ 22,400	\$ 1,308,659	0.287	0.00	0.00	0.00	106,8...	8760

# What is HOMER?

## Key HOMER concepts:

- ***sensitivity analysis***: a method of examining the effects of variation in external factors  
(e.g., fuel price, wind speed, interest rate)



# What does HOMER look like?

## Simple input screens

**Component Inputs**

PV | Wind Turbine | Hydro | Generator | Battery | Inverter | Electrolyzer | Grid | Misc | Help

AOC 15/50  
BWC 1500

Wind turbines generate electricity from the wind. This page allows you to select a particular wind turbine model and enter appropriate cost data.

Turbine type: **AOC 15/50** Details... New... Delete

Turbine properties:  
 Manufacturer: Atlantic Orient  
 Current: AC  
 Notes: Please see www.aocwind.net

Costs

Quantity	Capital (\$)	Replacement (\$)	O&M (\$/yr)
1	110000	90000	3000

( ) ( ) ( )

Other

Lifetime (yrs)  ( )

Power curve scaling factor  ( )

Wind speed scaling factor  ( )

Cancel  
OK

**Power Curve**

**Cost Curve**

# What does HOMER look like?

## Tabular and graphic outputs



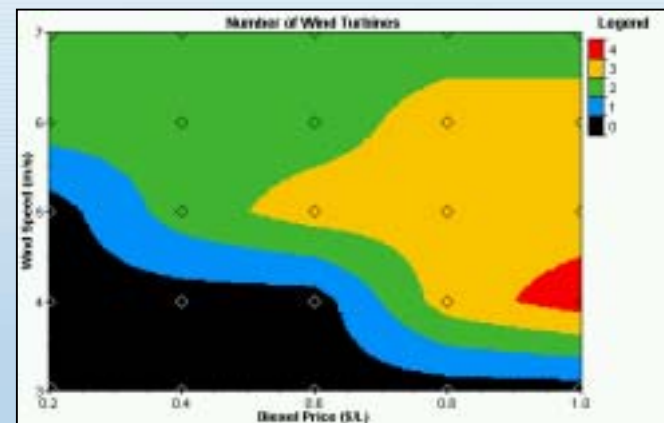
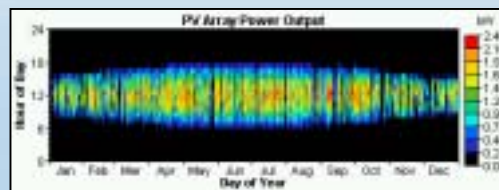
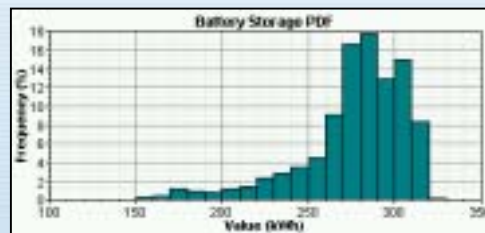
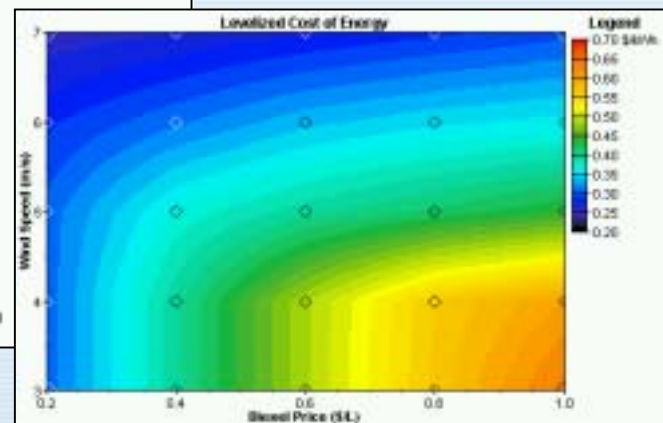
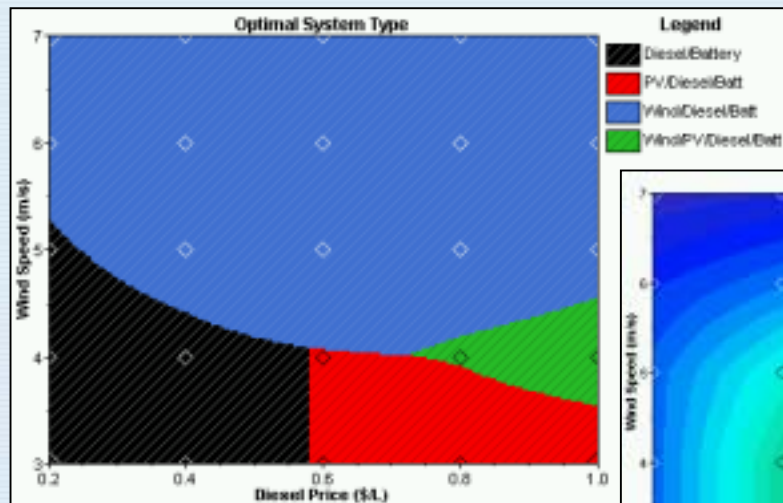
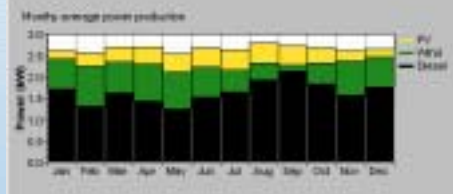
Summary Breakdown Production Energy Diesel Battery Hourly Data

Component	Initial Capital (\$)	Annualized Cost (\$/yr)	Annualized Capital (\$/yr)	Annual O&M (\$/yr)	Annual Fuel (\$/yr)
PV Array	12,800	1,812	902	28	0
Generic 26/4	11,800	1,120	960	176	0
Diesel	7,800	3,673	1,228	598	1,047
Battery	5,840	1,700	1,560	128	0
Inverter	2,917	420	398	33	0
Totals	30,257	7,934	5,149	938	1,047

Summary Breakdown Production Energy Diesel Battery Hourly Data

Annual energy production:

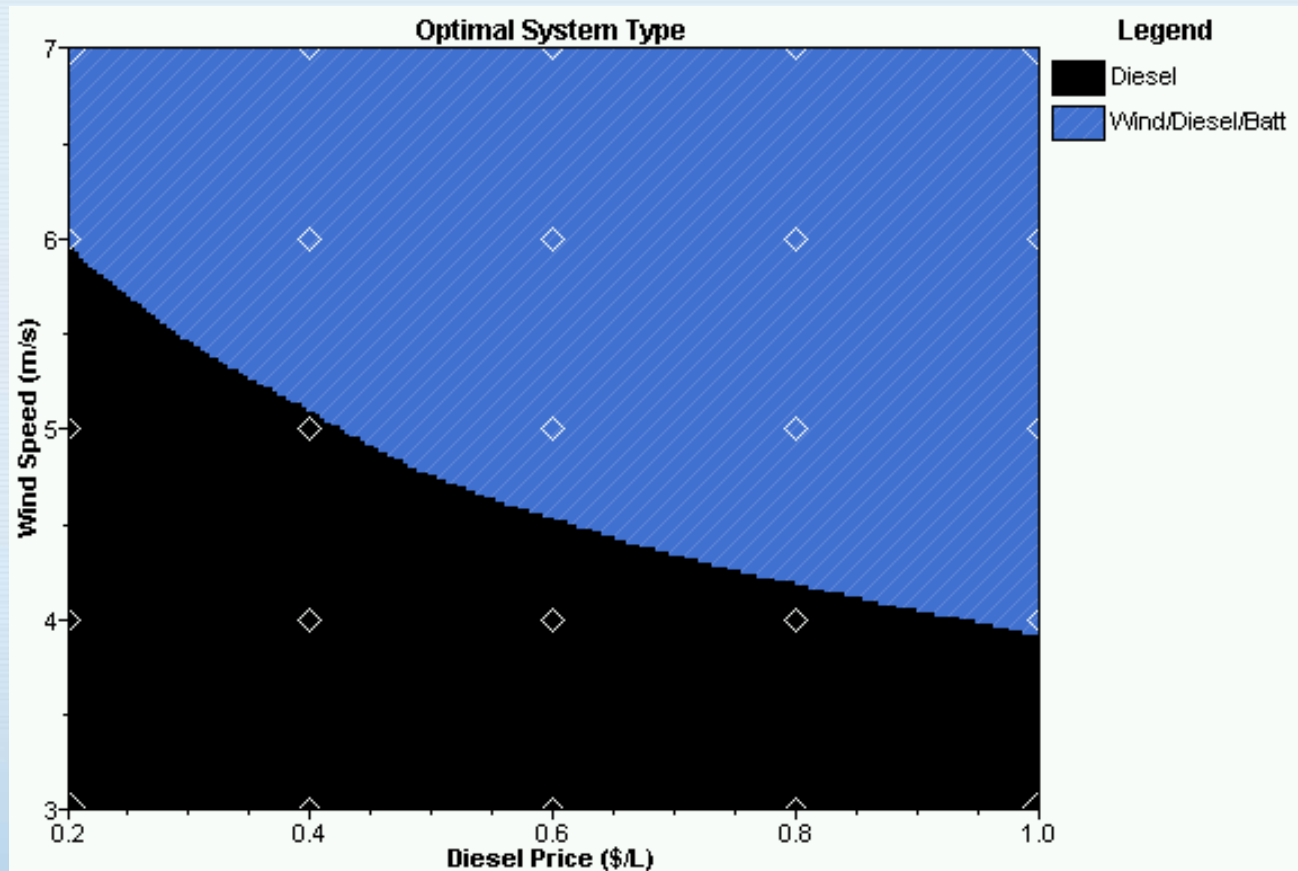
Component	Annual Energy Production (kWh)
PV Array	5,185 kWh (13.3%)
Wind Turbine	5,785 kWh (24.5%)
Diesel	14,484 kWh (62.2%)
Total Production	25,454 kWh
Renewable Fraction	0.22%





# What can HOMER do?

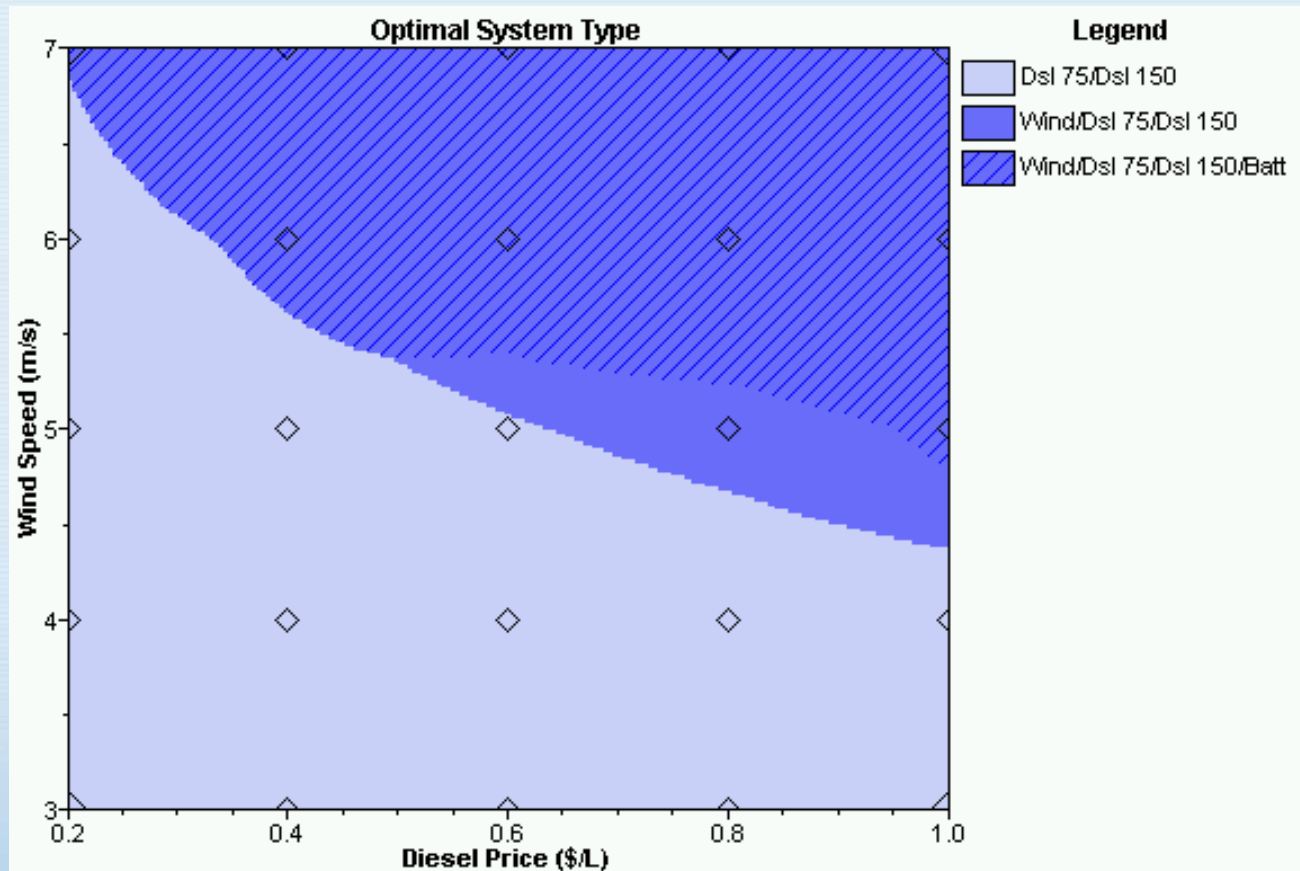
## When does wind compete with diesel?



(63 kW peak load, 33 kW average load, 70 kW diesel, 50 kW wind turbine)

# What can HOMER do?

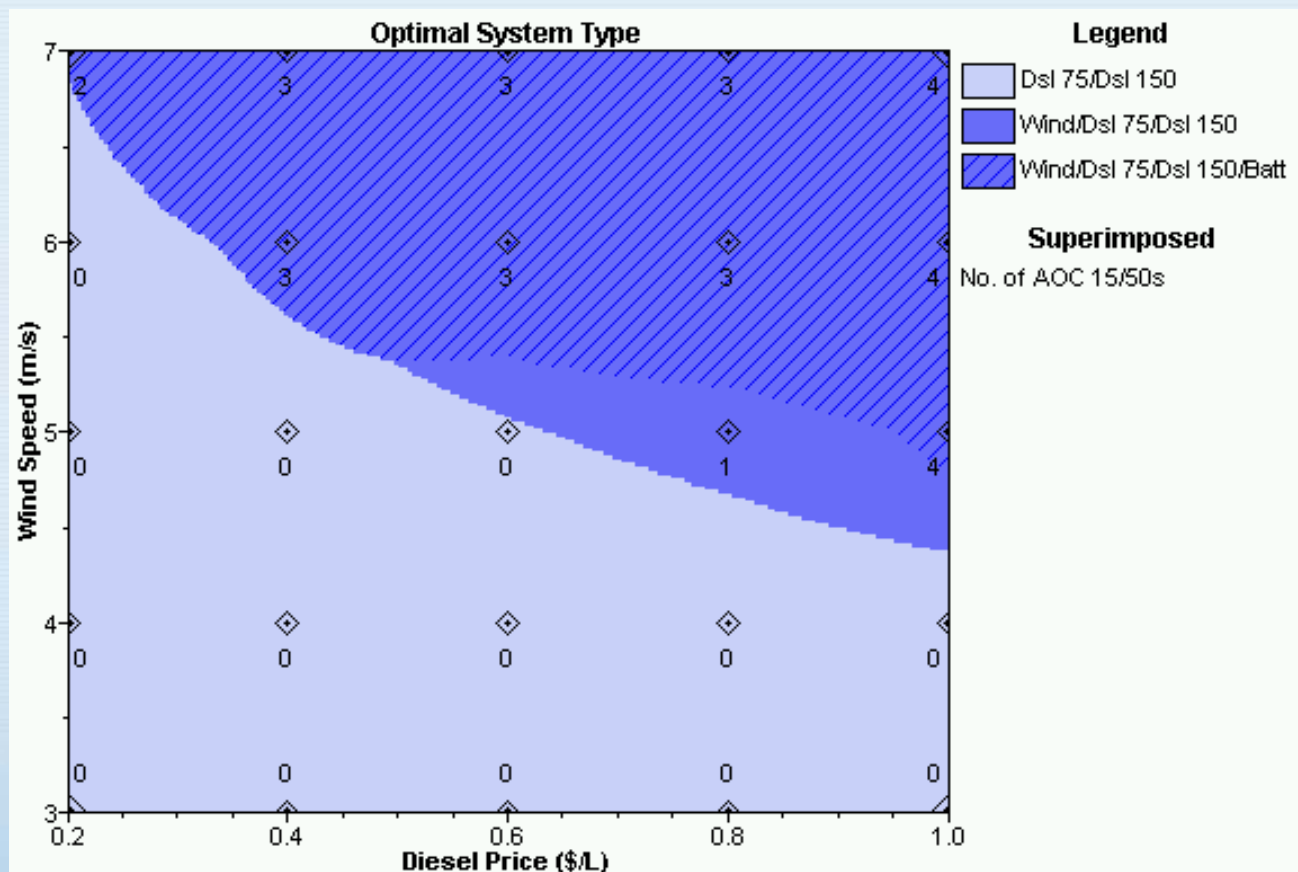
## When does wind compete with two diesels?



(130 kW peak load, 65 kW average load, 75 and 100 kW diesels, 50 kW wind turbine)

# What can HOMER do?

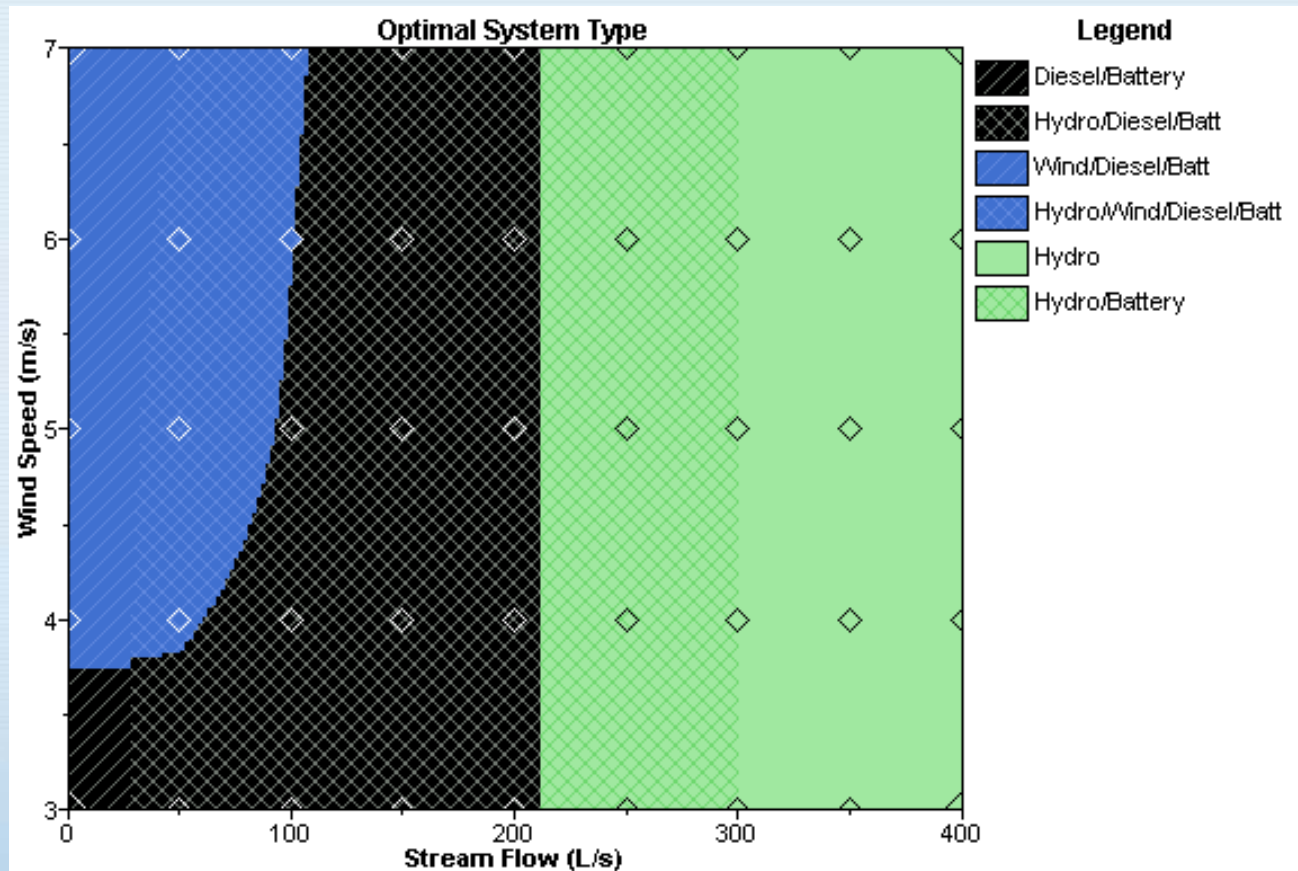
## When does wind compete with two diesels?



(130 kW peak load, 65 kW average load, 75 and 100 kW diesels, 50 kW wind turbine)

# What can HOMER do?

## Do hydro/wind systems make sense?



(48 kW peak load, 17 kW average load, 60 kW diesel, 50 kW wind turbine)

# HOMER and Hybrid2

## HOMER and Hybrid2: what's the difference?

- **HOMER:** rapid simulation, optimization, what-if analyses
- **Hybrid2:** more detailed and accurate simulation



# How do I get HOMER?

<http://www.nrel.gov/international/homer/>



# How do I find out more?

Email:

[peter\\_lilienthal@nrel.gov](mailto:peter_lilienthal@nrel.gov)

[tom\\_lambert@nrel.gov](mailto:tom_lambert@nrel.gov)